



Books of
knowledge
for children

Inventions & Discoveries



A richly illustrated exploration
of the world's greatest finds

Wonder World Series

*BOOKS OF KNOWLEDGE
FOR CHILDREN*

INVENTIONS & DISCOVERIES

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VASAN PUBLICATIONS

1. Who discovered electricity?

Electricity exists all around us. It is present when a cling film sticks to our hand, when we rub a rubber balloon or a polyester dress. It even lights up the whole sky during a thunderstorm. Man today cannot imagine a life without electricity. Right from the moment he wakes up in the morning, he needs it. He requires it for the electric bulb, fan, radio, television, computer and heater. Even trains and cars use electricity today. It is one of the greatest gifts to Man. Do you know who really discovered electricity?

It is surprising to know that electricity has been studied for thousands of years. The word

'electricity' comes from the Greek word *electron*. It meant 'amber'. As far back as 600 BC, the Greeks were aware that if a piece of amber was rubbed, it

attracted bits of cork and paper.



Power

Much later in 1672, Otto von Guericke produced a more powerful charge when he held his hand against a ball of spinning sulphur. In 1729, another scientist, Stephen Gray, discovered that metals had the capability of carrying electricity from one place to another. He named them 'conductors'. On the other hand, he realized that certain materials did not pass electricity at all or were very weak conductors of it. Examples of these materials were wood, paper, wax, glass and sulphur.

4. ☐ Inventions & Discoveries

In 1733 a Frenchman called du Fay discovered that there were two different kinds of electricity. He discovered the positive and negative charges of electricity. This was a very crucial step in the advancement of knowledge of electricity.

Benjamin Franklin is said to be the real discoverer of electricity. Franklin (1706-1790) was a US scientist, statesman, printer, publisher and author. He believed that lightning was a form of electricity. He decided to test this by flying a kite, with a metal spike attached, into a storm cloud. The metal spike would attract the lightning bolt, and the cord (wet with rain), would conduct the lightning downward. The cord was tied to a key, which was attached to an electrical condenser. On 4th July 1752, he conducted his experiment in Philadelphia. His experiment was successful and he was extremely lucky that the lightning did not kill him!

Franklin proved with his experiment that lightning is a form of electricity. He gave a scientific explanation of electricity. He explained that all substances in nature contain 'electrical fluid' in them. Friction between these substances removed the fluid from one and placed an extra amount in the other. Scientists today would say that this 'fluid' is composed of electrons, which are negatively charged. Franklin later on also invented the lightning conductor. This safeguards tall buildings from lightning strikes.

A very important invention in the science of electricity was that of the battery by Alessandro Volta in 1800. This is a very reliable and continuous source of electric current.

The main electricity that we get in our homes comes from the generators in the power stations. These are turned by turbines driven by the force of water or steam. The principle of the generator was discovered by Michael Faraday in 1831 in England.

2. Who invented the aircraft?

Man has always envied the birds for their ability to fly gracefully and smoothly in the sky. We have even read in the Greek myths about Icarus flying out of the prison with the help of feathers stuck together with wax. The idea



Aircraft

of flying has always fascinated Man and he has tried endlessly to soar into the sky. Leonardo da Vinci, painter and inventor, painted the picture of a 'flying machine' long before the aircraft was even invented.

Before the 19th century, flights in balloons and gliders had been carried out quite successfully. Short gliding flights were in gliders made by Sir George Cayley in England and Otto Lilienthal in Germany. This was not enough. Man wanted to be borne in the air for longer periods and longer distances.

There were those who were skeptical about whether a heavy machine would take off into the air. Professor Samuel Langley of USA built two machines driven by 1-1/2 horsepower steam engines in 1896. These models made successful flights. However his next model, a full sized flying machine, which he tested on 7 October 1903, wrecked in flight.

The same year saw the birth of the modern aircraft. Two brothers, Orville and Wilbur Wright, designed a heavier than air machine. They tossed a coin to see who would test ride the first flight. Wilbur won the toss. Unfortunately there was some technical snag and the machine did not take off. Three days later, on 17 December, near Kitty Hawk, North Carolina in USA, they tried again after a few changes in the design. This time it was

Orville's turn to fly in their invention. It took off smoothly and was airborne. This flight of 30 m lasted for just 12 seconds. Orville became the first man to fly an airplane. The second flight, by Wilbur, was somewhat longer and lasted for 59 seconds for a distance of 260m. Powered flight had been achieved. After this the Wright brothers began to manufacture planes for the War department of USA.

In 1909, Louis Bleriot flew across the English Channel. Ten years later, Alcock and Brown made the first non-stop flight across the Atlantic. Soon planes began to be used in warfare and for carrying mail across the continents. Passenger flights began after the World War I. The first jet aircraft, the Heinkel He -178 was developed in 1939. They came into use after World War II. The first jet airliner, the De Havilland Comet, began flying in 1952. Today, we have many different kinds of aircrafts in the world. Passenger aircraft, like the Boeing 747 and the Concorde, ferry thousands across great distances. Military airplanes come in various sizes and shapes and with the latest technological equipment. Even as we read these words, new designs of planes are being planned, for Man loves to soar like the birds!

3. Who discovered the laws of gravity?

Gravitation is the force that holds us all down to the surface of the Earth. Anything thrown upwards falls back to the Earth. It is not only the Earth that has the pull of gravity but also every thing else in the Universe. Everything in this Universe attracts every other body to itself.

Early scientists believed that the speed with which an object hits the ground from any height depended on the weight of the object. It was Galileo (1564-1642), who made a serious effort to study the force of gravity. He went to the top of the Leaning Tower of Pisa and dropped objects of different weights. He showed that objects heavy and light when dropped together reached the ground at the same time. He proved that they had the same constant

acceleration.

In another experiment, Galileo rolled a ball down a slope. With this he proved that a body moving on a perfectly smooth horizontal surface would neither speed up nor slow down.

Sir Isaac Newton (1642-1727), the English physicist and mathematician laid the foundation of modern physics. It was he who discovered the law of gravity. As a young boy while sitting under an apple tree he began to wonder why objects always fell down instead of going up. His mind dwelled on this subject for a long time. As he grew older he started to investigate the phenomenon of gravitation. Finally in 1685 Newton expounded the Universal Law of Gravitation. According to this law, all objects fall to the Earth with the same acceleration regardless of mass. He wrote down in great detail his observations and theories with mathematical calculations. His famous book, *Principia*, was published with the aid of Edmond Halley, the English astronomer who financed it.



Gravity

Much later Albert Einstein attempted to explain what is gravity. His theory was a very complicated one that required a very scientific mind to understand it. As science has taken leaps and bounds in the field of astronomy we now know that the force of gravity is 6 times more on the Earth than on the Moon. The planet of Jupiter has a still stronger force of gravity. A person on that planet would weigh three times more than he would on the Earth.

4. Who invented the telescope?

Since the early days of the human race Man has always gazed at the skies in admiration, fear and in wonder. The Sun, stars and the Moon have held his gaze for ages. Unfortunately they were all so distant that he could not really make out what they were or what they were made of. He did not even know where the Earth was located in the Solar System. In fact he thought that it was the central body round which the Sun and the planets revolved.



Telescope

Galileo Galilei was born in the Italian town of Pisa in 1564. He was very talented boy and kept himself busy making many scientific toys. He observed keenly things around him. All this paid off when he grew into an adult.

Galileo was very interested in astronomy. He spent several nights studying the skies and the heavenly objects. He was not satisfied watching the sky with his naked eyes. He wanted to see everything very clearly. His scientific mind soon came up with a solution. He invented the astronomical telescope. With the help of his invention he was able to study the Sun and its sunspots. He was also the first to sight the four moons of Jupiter, the mountains and craters on the Moon and study the appearances of Venus going through its 'phases', thus proving that it revolved round the Sun.

The telescope widened Man's sight to great distances. Galileo

was now able to make out the Universe more clearly. He understood quite clearly the validity of Copernicus' theory that the Sun was the centre of the Solar System. Copernicus (1473- 1543) was a Polish astronomer who had studied and worked in Italy.

Galileo, like Copernicus before him, defied the Christian Church, which at that time believed that the Earth was the centre of the Solar System. His views were published in a book. His statements offended the churchmen, as they did not comply with the accepted notions of that time. He was imprisoned for his 'blasphemous' views. They told him that they would free him if he retracted his statements. They even pressurized the old Galileo. However, he refused to budge from his stand. Ironically, the man who gave the human race the ability to see into the distant space became blind in 1637. He died in 1642.

5. How was the telephone invented?

One of the most important methods of communication these days is through the telephone. It is so simple and easy to use the telephone. Just press a few buttons and we are connected to the other person. We really do not realize how much work has gone into inventing the telephone, which is now part and parcel of our life in the homes, offices, factories and hospitals.

The word telephone comes from the two Greek words, *tele* meaning 'far' and *phone* meaning



Telephone

'sound'. Telephone therefore means 'sound coming from far'. The telephone was invented by Alexander Graham Bell in 1876. He was a Scottish born US scientist and inventor (1847- 1922). He had been experimenting with the idea of sending several telegraph messages over the same wire at the same time. He was working in Boston, USA, during that time. On 2 June 1875 he was experimenting with a set of spring -steel reeds. The receiving set was in front of him while the sending set was in the next room. It was being operated by his assistant, Thomas Watson.

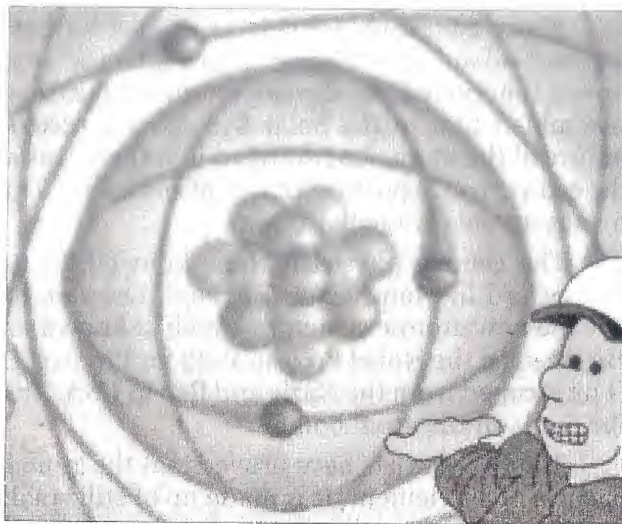
Watson plucked the steel strip and it began to vibrate producing a twanging sound. Bell rushed in from the other room and excitedly asked him to repeat what he had done. When Watson did so Bell realized that the steel strip while vibrating over the magnet had caused a current of varying strength to flow through the wire. This had made the reed in Bell's room vibrate and produce a twanging sound. Bell's sharp mind had quickly observed this and it led to the next step in the invention of the telephone.

The next day the first telephone was made. Voices could be recognized over it. The first telephone line was from the top of the building to the second floor below it. Graham Bell spent another year in refining the design in order to make the words clearer. Finally on 10 March 1876 the first clear sentence was heard over the telephone line. The famous first sentence was " Mr. Watson, come here, I want to see you."

Today the whole world is connected with the help of millions of telephone lines. These are linked together by a very complicated network. This network consists of a telecommunications network. It carries fax messages, television and radio signals, computer data as well as telephone calls. Thanks to Alexander Graham Bell.

6. Who discovered the atom?

All matter in this Universe is made up of different kinds of elements. There are about 100 types of elements. Elements are in turn made of atoms. These atoms are so tiny that they cannot be seen with the naked eye. Only a powerful microscope will reveal these



Atoms

atoms. In fact a pinhead contains about 10,000 atoms.

The idea of the atom is not a modern one. The early Greeks believed that all matter was composed of atoms. According to them if something was divided continuously till it could not be divided further, the last bit was an atom. In fact the word *atom* comes from the Greek language which means 'unsplittable' or 'undivisible'. The Greeks however, spoke of the atom in a philosophical way and not as a scientific idea.

In 1803 John Dalton proposed the theory of atoms. Dalton (1766-1844) was an English chemist and mathematician, who was the first man to develop a scientific atomic theory of atoms. He considered the atom to be the smallest part of matter. Dalton carefully weighed different samples of gases, solids and liquids and discovered that they weighed different. He realized that all matter was made up of extremely tiny particles, which he too called atoms. When Dalton stated that the atoms of different elements have different properties and different weights, he started the scientific knowledge of the atom. Dalton's work on the nature of matter provided the basis for modern atomic theories. He devised a system of classification by atomic weight. His work on gases led him to

formulate the law of partial pressure of gases, which came to be known as Dalton's Law.

About a hundred years later, Ernest Rutherford (1871 - 1937) a New Zealand physicist, tried to explain what the atom was and how it functioned. He developed the atomic theory, which closely resembled that of the Solar System. He recognized the nuclear nature of the atom. According to him there was a heavy nucleus in the centre, with a positive charge of electricity. This was surrounded by negatively charged electrons.

The Danish physicist, Niels Bohr (1885-1962) worked with Rutherford in Manchester, England. Later on his own he worked out the new atomic structure which is known as the Bohr model. He received the Nobel Prize in 1922 for Physics. During World War II he escaped from the Nazis and fled to USA. There he took part in the work on the atom bomb.

Today scientists have proved that the atom is not the smallest particle of an element. It is made up of still smaller particles. That was the work of another great scientist.

7. How was dynamite invented?

Dynamite is a kind of explosive. There are two kinds of explosives-low explosives like gun powder and high explosives like dynamite and gelignite. Explosives are used in war as well as for peaceful purposes.



Dynamite

Explosives have played a great role in the history of the different countries.

It is believed that the first explosive to be discovered was gunpowder. The Chinese used it as early as the 9th century AD. They were originally used for making fireworks. It was only much later that it began to be used for firing guns when the European nations began using it in the 14th century. At that time gunpowder was made from a mixture of potassium nitrate (saltpetre), charcoal and sulphur. This mixture continued to be used till the end of the 19th century.

In 1845, Schoenbein, a German chemist, experimented with different materials trying to make an explosive, which would be even more powerful than gunpowder. He treated cotton fibres with a mixture of nitric and sulphuric acids. This resulted in the production of nitro-cellulose, or guncotton, which was a fibrous product resembling cotton. It had a more explosive effect than the existing gunpowder.

At around the same time, an Italian chemist, Ascanio Sobrero, was also experimenting with different chemicals in order to make a powerful explosive. He added glycerin to nitric and sulphuric acid to make nitroglycerin. This was an even more powerful explosive than guncotton.

Nitroglycerin was a very explosive material. It presented great danger especially in transportation. Alfred Bernhard Nobel, a Swedish chemist and engineer, tried to solve this problem. He had found a less dangerous way to produce nitroglycerin but it was still not safe enough for handling. It still tended to explode during transportation.

One day, Alfred Nobel discovered that one of his cans of nitroglycerin had leaked into the box of kieselguhr in which they were stored as a safety precaution. Kieselguhr is a kind of light earth of volcanic origin and is absorbent and chalk-like. The mixture of nitroglycerin and kieselguhr formed a kind of hard mass. Nobel recognized in this mixture the solution to his problem.

Thus dynamite was discovered in 1866. It was an excellent explosive, which was less sensitive to shock.

Dynamite is used in bombs and for rock blasting. It is not set off by heat but needs a small explosion from a detonator to make it blow up. Dynamite is used extensively these days in war as well as in peaceful jobs. Old buildings are often demolished using dynamite. They are also used for blasting rocks in quarries and in mountain sides for making tunnels and roads.

8. When was the parachute invented?

A parachute refers to any canopied fabric device that is strapped to a person or thing. It is generally umbrella shaped and used to slow down the descent from a high altitude. The parachute resists the movement of air past them, acting as a sort of brake. This results in a soft

landing. The person feels no more shock than if he had jumped down from a 3 metre high wall.

Long before the invention of planes, people tried to jump off heights using different devices for safe landing. Leonardo da Vinci (1452-1519), the famous Italian painter, sculptor, and scientist, sketched a parachute design way back in 1514. Later in 1595, Fausto Veranzio published a description of a workable parachute. In 1785, a Frenchman, J. P. Blanchard used a parachute to drop a dog from a hot-air balloon high in the sky.

The first man to use a parachute was Andre- Jacques Garnerin



Parachute

in 1797. He made his first successful jump in Paris when he jumped off from a hot- air balloon from a height of 670 m. He had made a umbrella shaped parachute of white canvas, which had a diametre of 7m. He landed safely leading the way for future parachutists.

The design of the parachute went through different processes. It was not till 1912 that the first successful descent in a parachute was made from an airplane. The descent was made by Capt. Albert Berry from a height of 457 m over Missouri, USA. The following years saw a lot of discussions on the safety of parachutists jumping off planes. It was not considered safe, as it was feared the pilot would not be able to clear the plane and escape without entangling the parachute.

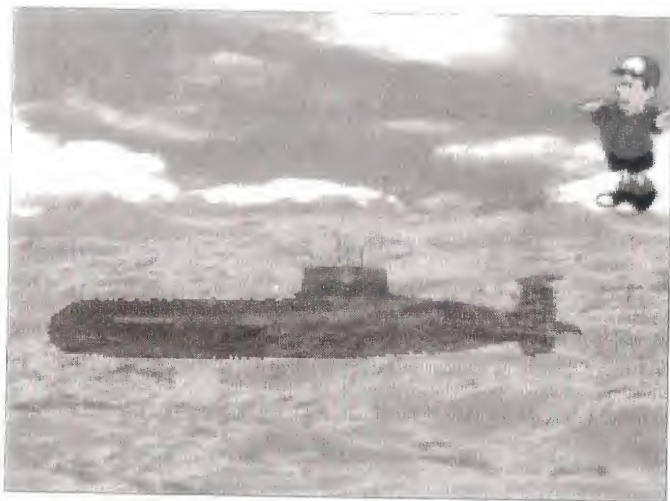
Modern parachutes are variously shaped, often small and rectangular. They are designed to enable the parachutist to exercise considerable control of direction as in skydiving. Parachutes are folded into a pack. When require it is released by a rip-cord or some similar device. It consists of about two dozen panels of nylon in a circular or rectangular canopy with shroud lines to a harness. Earlier silk was used in place of nylon.

Today parachutes are used for various purposes. During World War II parachute troops proved vitally important. Parachutes are used for dropping supplies to areas far from roads or rivers or during floods. They are used for sports like skydiving. They are sometimes used to aid in braking the landing of a plane or missile. Huge parachutes are employed to slow down the Space Shuttle as it lands.

9. Who devised the submarine?

Man has always wanted to conquer every part of the Earth, be it the land, skies or the water. He has tried to reach the depths of the deep oceans in order to get pearls or for the simple pleasure of studying the mysterious regions. However, unlike fish, Man has not got the ability to stay underwater for long periods of time. So his ingenious brain began to devise methods to do so.

In 1578, a British mathematician, William Bourne, published a book in which there was a design of a boat, which was completely enclosed. It consisted of a wooden



Submarine

framework covered with waterproofed leather. However Bourne did not actually build it.

In 1620 a similar boat was built using this design. The Dutch inventor, Cornelius Van Drebbelle, launched the first submarine for James I. He manoeuvred it in the River Thames many times at depths of up to 3 to 4 metres. The first proper submarine was the *Turtle*, an egg shaped wooden vessel built by the American engineer, David Bushnell. It was used to attack British boats during the American War of Independence in 1776. It was a one-man submarine that was hand operated by a screw propeller.

Robert Fulton designed a submarine, *Nautilus*, for Napoleon to use against the British. By 1727, at least 14 different types of

submarines had been made in England alone. In 1875, the Irish emigrant to US, John Holland, built a series of submarines. These were used extensively by the Americans and the British by the turn of the century. The modern naval submarine has descended from them.

Submarine warfare was established as a distinct form of naval tactics during the World War I. Submarines from the ocean-going to the midget types played a very vital role in both the World Wars. The German boats caused great losses to the Allied merchant shipping.

Most submarines these days are used by the navy, all over the world. They patrol the oceans and fire torpedoes or missiles if necessary. There are different kinds of submarines which are used for engineering and exploration purposes. They are very useful in oceanography.

10. How was glass discovered?

Glass is a transparent or translucent substance. It is physically neither a solid or a liquid. Although it is easily shattered, it is one of the strongest substances known. . No one really knows when exactly the secret of making glass was first learned. The chief ingredients of glass are certain types of sand (silica), soda ash, or potash and lime. These materials are available all over the world easily. Any country could have started making it.

According to tradition, the Phoenicians are the first ones to have learnt the secret of glass making. It seems some sailors used



lumps of niter (a sodium compound) to balance their kettle on the fire. The heat melted the niter, which mixed with the sand on the beach and flowed out as a liquid stream of glass. We really do not know whether this story is true, but we do know that the Syrians were using glass 5000 years ago. They were the original makers of glass. Their merchants sold glass ornaments and decorative pieces in the Mediterranean countries.

It was the Egyptians who first blew molten glass to make glass vessels. They went one step further. They gave a red tint to the glass by adding copper to the molten mixture. Egyptians also mixed crushed quartz to sand to change the colour. They soon learnt to make blue, green and purple coloured glass by adding cobalt, and manganese to the molten glass mixture.

Later on the Romans too excelled in glass making. They used glass in thin sheets for wall coating. By the Christian era glass began to be used for windowpanes.

Where ever we look we see glass all around us. Windowpanes, tumblers, windscreens, bottles and decorative pieces. Even things like telescopes, microscopes, computers, TVs, and spectacles make use of glass. Glass comes in different forms too. Sheet glass is the cheapest form of glass. Other types of glass are float glass, moulded glass, soda glass, flint glass, optical glass, stained glass and heat resistant glass. There is even bulletproof glass strong enough to resist machine gun fire.

11. Who discovered curare?

Curare is a poison extracted from the bark of a particular climbing vine found in South America. It is black in colour and very lethal. The hunters of the Amazon Basin used it to paralyze their prey and block simulation to their nerves resulting in a fatal death. Amazingly, this same poison can be used to save lives. Curare is a wonder substance that can both kill and save lives.

Another name for curare is 'flying death' and it was used by

the Indians of South America. They used it to tip their darts for killing animals. The slightest scratch from these poisoned darts would kill the animal in minutes. It can kill a bird in seconds, a man in 5 minutes and a big ox in less than 30 minutes. To date, no wholly reliable antidote has been found for curare.

The effects of curare interested the European explorers of the 16th century. They returned home to tell their countrymen of its lethal properties. Several scientists began to be interested in this wonder bark. However they could not make much headway, as the forests of the Amazon Basin were so inaccessible and dangerous.

It was only in the mid- 19th century that they could investigate this poison. By 1847 scientists had worked out the way curare worked. They also successfully experimented on keeping a victim of curare poisoning alive by artificial respiration. However they had still not been able to get the active ingredient of curare. Nor did they know the plant from which this poison was obtained.

It was in 1935 that an English doctor, Harold King, finally identified the main paralyzing agent in curare. Fortunately the same year also saw the identification of the plant by the German botanist, Guillermo G. Klug. This led to the production of standard strength curare by the drug companies. It is one of the most powerful drugs in medical science.

Curare was first used as a relaxant in the treatment of paralysis. It was administered for the first time as an anesthetic during a surgery by Dr. Harold Griffith in 1942 in Montreal. These days, curare is used frequently as a muscle relaxant during surgery. It is better than many other anesthetics as the patient requires a very little amount and the recovery from its effects are even more rapid.

12. Why is Edison considered to be one of the greatest inventors?

Thomas Alva Edison (1847- 1931) was not a scientist. In fact he was a self-taught man. He had no theoretical or mathematical background. Today his name is among the greatest inventors of all time. During his lifetime he invented about 1000 new things. Most of this success came from perfecting the ideas of other people or improvising on the inventions of others.

Edison was born in Milan (Ohio, USA) on 11th February 1847. He was expelled from school, as he never cared to study. However, after this incident he began to study science books. He had always been interested in this subject. As a ten-year-old boy himself he had a chemical laboratory in his house. As he was not very well off financially, he sold candy and newspapers in the trains. This was not enough. When he grew older he bought an old printing press and began printing newspapers in the luggage car of the train. He also

had his laboratory along with the printing press. When this caught fire one day, the railway authorities threw all his belongings out. Later a train accident deprived him of his hearing.

In 1862 Edison began to learn telegraphy from a grateful man whose child he had rescued from a train accident. In 1868 Edison got his first patent on telegraph. In 1869 he got a patent for inventing an automatic vote recorder. He also worked on improving the typewriter. In 1871 he made an improved stock ticker. This helped to make a lot of money. He then founded his own manufacturing plant in Newark, New Jersey.



Edison

His most famous invention was that of the incandescent electric bulb in 1879. He constructed a system of electric power distribution to consumers. His improved electric bulbs were soon used for street lighting. Edison's lights were appearing in the streets of New York. They were powered from the Pearl Street Power Station. It was established in 1882. Power generating stations of the world today are very similar to the original one. Street lighting had come of age. Earlier streets were lit with kerosene lamps. The roads were quite dark and ill lit. The invention of the electric light made a very strong impact especially on the crimes committed on the dark roads.

Today we take electric lights for granted quite forgetting the dedicated efforts of the great inventor, Edison. In 1889, he set up the Edison Light Company, which today is called the General Electric Company.

Edison went on ahead to invent the movie camera, mimeograph, fluoroscope and an improved version of the battery. He has a long list of inventions to his name. No wonder, Edison is said to be one of the greatest inventors of the world.

13. Who invented the compass?

Compasses are instruments for finding the direction. They point to the north and accordingly the rest of the points of direction can be discerned. Compasses are used for navigational purposes in ships and planes. They are also used during



hiking and for general orientation. For this there are small portable compasses available.

A compass has a small-magnetized pointer or needle, which is hung, pivoted or floated in order to allow it to move freely. The needle always points to the north as the Earth's magnetism always attracts it.

No one really knows when exactly the compass was invented. It is generally believed that the Chinese were the first to use it. Simple compasses using lodestone, a magnetic rock, may have been in use in China in the 5th century BC. Certain historians say that the compass has been referred to in a Chinese book dating to the 11th century AD.

The Arab merchants learnt the use of the compass from the Chinese. They in turn introduced this instrument to the European sailors. It is a well-known fact that the compass was in common use in the European countries by the 12th century. During those days the compass consisted of a lodestone attached to a wooden crossbar which was allowed to float in a bowl of water. The lodestone always pointed north. They also discovered that a steel or iron needle kept in contact with a lodestone long enough gained magnetic properties. These needles thus replaced the lodestone.

There was however one problem with these compasses. Today we know that the Earth's magnetic north and the true north are not the same. In those days the sailors were not aware of this and so often got confused. In modern days this problem is solved by using gyrocompasses. These are non-metallic and give the true north bearings with the help of a gyroscope. Once a gyroscope is spinning it is very difficult to change its direction.

14. Why is Marconi considered to be such a great inventor?

Guglielmo Marconi (1874- 1937) made several valuable contributions to science. One of the most important being that of the radio. Marconi was an Italian engineer who was born on 26 April 1874 at Bologna (Italy).

It was during this time that Heinrich Hertz (1857-1894), a German physicist, who studied electromagnetic waves, showed that their behavior resembles that of light and heat waves. The unit of frequency, hertz, is named after him. When Marconi heard in 1887 that Hertz had discovered radio waves, his imaginative mind began to think of the possibilities of sending messages on these waves. At that time messages were sent long distance in the Morse code using electric wires.

Marconi worked on this problem for sometime. He was able to develop an electric bell that could be operated on from a distance of 9 metres with the aid of radio waves. He continued to work on this till he developed equipment that could transmit pulses up to about half a kilometre. He had achieved radio communication. In the meantime he was dissatisfied with the lack of interest shown by the Italian government in his research. It resulted in his shifting his base to London in 1896, where he felt his work would be recognized.

In London, in 1896 and 1897 he demonstrated the wireless telegraphy apparatus he had successfully developed. He had



Radio

improved radio communication to a distance of about 19 kilometres.

Marconi formed the company that was called Marconi's Wireless Telegraph Company Ltd. in 1887. Two years later he transmitted a radio communication across the English Channel, which is about 50 kilometres in width. The next year he installed two US ships with radio equipment in order that they could report to the newspapers in New York City the progress of the yacht race for the American Cup.

Marconi could not rest as he still strived to improve his own invention. In 1901 he sent the letter S in Morse code across the Atlantic Ocean. It thrilled people all over the world as they foresaw the countless uses of radio waves. In 1909 Marconi was awarded the Nobel Prize for Physics.

Marconi continued to work on short-wave wireless communication. It is the basis of the modern long distance radio. The Italians finally recognized his worth. In 1930 he was chosen the president of the Royal Italian Academy. Marconi died in 1937 after giving so much to the world.

15. Who started vaccination?

Vaccination is the injections we take to prevent us getting certain diseases. They are also known as immunizations. These injections consist of harmless dead germs or substances extracted from them. They are then injected into our body making its natural defence system produce antibodies, which kill germs and the protective white blood cells combat that type of infection. Later on in life if the body is invaded by these germs it is ready to destroy them immediately. Thus these vaccinations prevent us from falling sick.

It was Dr. Edward Jenner, an Englishman, who began

vaccinations. One day as a young medical student in London, he overheard a milkmaid saying that she had no fear of catching small-pox as she already had cow-pox. Smallpox was a very dreaded disease raging in the country then. Cowpox was a milder disease with similar symptoms. The remark of the milkmaid continued to stay in his mind for many years.

In 1773 he returned to his village in Gloucestershire. For the next 20 years he devoted his entire spare time in

the investigation and research into the statement that continued to occupy his mind. After years of research he finally came to the conclusion that the milkmaid was right. There were very few people who had caught smallpox after they had had cowpox.

Jenner started his first experiment in 1796. He gave a child a light dose of cowpox in order that he would not catch the wretched plague of smallpox. In 1798, he made an even more important experiment when he inoculated four children with small pox. They had been earlier inoculated with cowpox. His experiment proved very successful as none of the four children caught the fatal disease.

Jenner's vaccinations helped wipe out this terrible disease which was extremely prevalent during that time. His method, the application of an infective agent to an abraded skin surface is still used in smallpox inoculation to this day.



Vaccine

16. Who discovered penicillin?

Penicillin is an antibiotic drug. There are several antibiotics these days. Antibiotics are drugs which are useful in the prevention and treatment of infections. 'Anti' means against and 'biotic' means life. Antibiotics work against disease producing bacteria. Antibiotics are themselves made from bacteria, molds or larger plants. The first one to be discovered was penicillin. It is used today to treat serious infections by various germs. Even sore throats, boils, pneumonia and wounds are treated with penicillin.

Penicillin was discovered by Sir Alexander Fleming in 1928. It was an accidental discovery, which led to great advancement in medical science. Fleming (1881-1955), a Scottish bacteriologist, had actually been doing research on another subject when he chanced upon this discovery.

In 1922 Fleming discovered lysozyme, which was an antibacterial enzyme present in the saliva, nasal secretions and in tears. While studying this he found an unusual mold which was growing in a neglected culture dish. It seemed to inhibit the growth of bacteria. He isolated that particular culture dish and grew it into a pure culture. Thus penicillin was discovered accidentally all because a scientist had neglected to clean his culture dish! The green mold that grows on bread is *penicillium glaucum*. There is a mold very much like it found in the soil called *penicillium notatum* from which we get penicillin.

Between 1939 and 1941, two other researchers, Howard Florey and Ernst Chain, resumed Fleming's initial work. Penicillin was eventually patented in 1943. Penicillin began to be commercially produced and was widely used during the World War II. Alexander Fleming shared the Nobel Prize in 1945 for Physiology and Medicine together with the other two researchers.

Fleming's discovery led other scientists to search for other antibiotics. Streptomycin, aureomycin, chloramphenicol and terramycin were the other antibiotics discovered. These days many of the penicillin used is semi-synthetic. Some of the factory made ones are used to kill germs that are not killed by the penicillin made from molds.

17. Who invented the elevator?

An elevator, or lift, is a mechanical device that carries passengers or freight. It raises or lowers them to the desired height. Several high rise buildings have elevators installed in them in order that people can go to the different floors without much trouble and pain of climbing a series of staircases.

The modern elevator was not made in a single day by one particular person. In fact it has been developed down the centuries. The use of lifts to carry loads was known during the early Roman days. It was mechanically operated during those days. Vitruvius Pollio, the Roman architect of the 1st century, has described the use of lifts, which used pulleys and capstans. These platforms were hoisted with the help of man, animal or water power.

Years later in 1800 AD, the lifts began to be operated with the newly found steam power. By the 19th century, an even more reliable method was employed. The hydraulic lift was introduced. It had more power and could lift heavier loads and to greater heights. However these different forms of lifts were still not safe enough for people to be transported.

In 1852 US inventor, Elisha Graves Otis, developed the elevator. It was the first passenger safety elevator. It was finally installed in 1857 in the Haughwout Department Store in New York City. It was powered by steam and was able to climb five floors



Elevator

in less than a minute.

The next thirty years saw a lot of progress in its design. The elevator was operated by a hydraulic lift, which made it even faster. By 1894 the elevator began to be run on electricity. Push button system was introduced. Improvements were made in safety, speed and height. Speeds increased to 365 m per minute. Gradually the elevator was made more convenient and more economical.

Elevator operators used to work the controls and the gates from within the cab. By the 1950s elevators with automatic operations were introduced. This did away with the lift operators. With progress in the design and speed of the elevators the skyline of the cities also began to change. Elevators permitted the development of skyscrapers.

In modern times elevators are used for a variety of purposes. Not only are they used for passenger and operations, they are also used lifting freight in ships and for construction operations. They are also used in dams and rocket launches. There are several safety devices in them too. The Eiffel Tower of Paris was the first one to have a transparent see-through elevator. Now several buildings have installed them so that the passengers can enjoy the scenery as they go up or down.

18. When was the washing machine invented?

Washing clothes has always been an unpleasant task. The laborious and time consuming procedure of soaking clothes in a bucket of soap water, followed by the scrubbing and rinsing and the drying out of the clothes on the clothesline has always been a very tiring job. The end result is that the clothes do not turn out to be very clean. The dirt has to be really forced out of the clothes. For this purpose millions of people have turned to the highly efficient washing machine.

The first washing machine was made in 1858 by Hamilton

Smith of Pittsburgh, Pennsylvania (USA). It was operated by turning a crank at the side, which rotated a set of paddles. Soon another was made that imitated the action of scrubbers on a washboard. However these models were



Washing machine

not very satisfactory. The clothes came out of the machine in a torn or tangled up condition.

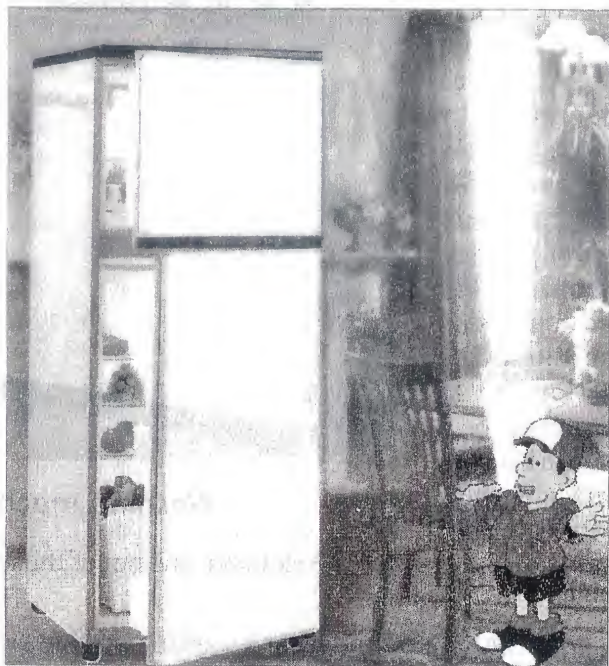
In 1907 a new model of a washing machine was invented. It was the first electric washing machine and was fairly effective in cleaning the clothes. Soon several models began to be introduced by 1912 and these were all electrically powered.

The earliest washing machine tubs were made of wood. The newer models were made of copper, galvanized steel, aluminium and zinc. By 1961 they began to make them of porcelain enamel so that they could resist strong soap detergents and temperatures of water. These days they are also made of strong plastic.

By 1922 the washing machine was improved further by installing an agitator in it. The machine was still semi-automatic. By 1937 the fully automatic washing machines were introduced. They can be left to the whole wash by themselves. They are controlled electronically. The user punches a set of buttons from a range of programs so that the machine hot-washes cotton clothes or cool-washes woollens. It sets the temperature of the water, as well as the time of the rinse. There are also machines, which have the tumble drier to dry out the clothes. Clothes washing have become a highly 'electronic' task today!

19. Who invented the refrigerator?

Refrigerators are machines for keeping things cold. They are used to store fresh food as well as frozen food in homes. Ships also have large fridges that can transport large amounts of food to different countries. Fridges work on the principle of evaporation. They remove the heat to make it cold.



Fridge

Refrigeration is not a modern idea. It was done during the ancient days too. Ice was the oldest method of refrigeration and was used by the Chinese in 1000 BC. Even wine was cooled in this way. Another method of refrigeration used during the early days was that of dissolving certain salts in water. Saltpetre and ammonium nitrate remove heat from the water in which they dissolve.

The process of evaporation is another method of refrigeration. Evaporation is the change of a liquid to vapour. If you put a little water on your finger and then wave your hand, you find that particular finger feels very cool. It is the same principle on which the refrigerator works. Refrigerators remove heat taking it away from the inside and giving it to the outside, which becomes

warmer. In refrigerators a special substance called a refrigerant does the cooling.

In 1748, William Cullen demonstrated artificial refrigeration for the first time, at Glasgow University. This discovery was however not put to practical use. In 1823, Michael Faraday learned how to change ammonia vapour to a liquid by compressing it and then removing the heat from it. When pressure is removed and the liquid is allowed to evaporate again, it takes up heat and produces cold. By controlling this process we have our modern fridges.

Carl Linde, a Swiss inventor invented the first refrigerating machine, in 1874. He used it to cool beer. In 1877 Linde used ammonia as the liquid in the machine. Modern fridges are based on the method. Freezers work in the same way, but are more powerful and give a greater cooling effect. In a freezer, food stays frozen at -18 degree centigrade.

20. Who invented the vacuum cleaner?

A vacuum cleaner is one of the necessities in a modern home. Earlier dust had to be cleaned out physically. It was a laborious task and resulted in the rest of the places getting dusty. A vacuum cleaner is electrically operated and is very easy to handle. It very conveniently removes dust from all the hidden corners in furniture, carpets and nooks and corners of the house.

In the early 1800s, several inventors tried making various household equipments. Most of the work done then was by trial and error. The earliest electric cleaners worked on a different principle. They blew out air in order to dislodge the dust. This was not a very successful household appliance as the dust blew out all over the house.

In 1901, H C Booth, a Scot, came up with another idea. He felt that the cleaner would be more effective if it reversed the process. It would suck the air in instead of blowing it out. He lay

down on the floor and began sucking through a handkerchief. To his delight the method worked. He set about perfecting his idea and built the first vacuum cleaner. Booth's original vacuum cleaner operated from the street by means of tubes running into the house.

A vacuum cleaner's motor turns a fan, which creates a partial, vacuum inside. The air inside rushes in, bringing the dust together with it. This is all sucked up through a tube into a bag. The dust is trapped here while the air escapes. Some cleaners have a spinning brush, which loosens the dirt so that it can be picked up easily. The industrial vacuum cleaners are very powerful and can even suck up wood shavings, broken glass and even liquid.

21. How was coffee discovered?

Coffee is an aromatic drink made from the roasted seeds of the coffee plant. It contains a stimulant called caffeine. There are different species of this plant the two main ones being, arabica, which grows mainly in South America and robusta, which grows mainly in Africa. Each has its distinctive flavour and aroma.

The story of its discovery is very interesting. According to legend the first creature to taste the invigorating effects of coffee was a goat. Kaldi, a young Arabian shepherd noticed that one of his goats was behaving in a very lively fashion after eating the berries of a strange plant. He too tasted these red berries and felt the same effect. A Muslim priest noticed this and on learning the secret from the boy, he tried the berries. That night the priest dreamt that Prophet Muhammad told him to boil the berries and to drink the liquid. This liquid would be successful in keeping the worshippers in the mosque awake. According to the Prophet, Allah had got tired of hearing their snores.



Coffee

The next day the Muslim priest did as instructed and the brew turned out a great success. The fame of this elixir spread beyond the mosque. Soon it had become a part of every Arab household. Muhammad had forbidden the drinking of wine. The Arabic for wine is *qahway*. It eventually changed to *coffee* in English.

By the 16th century, The Arabs had discovered that the red berry contained green seeds, which could be roasted, ground and simmered in water. The liquid was then filtered and drunk. Once again the Muslim priests began to be alarmed as devotees were spending more and more time in the coffeehouses and neglecting their prayers. They decreed that coffee be forbidden. The Caliph of Cairo, who was himself a passionate coffee drinker, immediately revoked the decree. Thereafter, coffee drinking again flourished and spread to the European countries by way of the traders who brought in great quantities to refresh the West.

The authenticity of this story cannot be established, but it is true that the Arabs were the first to discover the use of the coffee beans. It spread to Britain in the 17th century and the first coffeehouse was opened in Oxford in 1650. It soon spread to other countries refreshing millions with its aroma and flavour.

The coffee plant requires a warm climate to grow. Brazil is largest producer of coffee in the world. Columbia is the next. Coffee is also grown in countries like Nicaragua, Indonesia, Cameroon, India, Kenya and the West Indies.

22. Who invented the system of coinage?

Coins are a form of money. The right to make and issue coins is a state monopoly. The great majority of these coins are tokens in that their face value is greater than that of the metal of which they consist. The study of coins is known as numismatics.

The invention of coinage is generally attributed to the Lydians (now part of Turkey) during the early 7th century BC. They were wealthy and powerful people. Their coins were stamped and had

a guaranteed weight. They were made from electrum, which was a mix of gold and silver. They were the size and shape of a bean and were known as 'staters' or 'standards'. The first to issue gold and silver coins was Croesus of Lydia in the 6th century.

The idea of using coins soon spread to the Greeks who began to use them from the 6th century BC. The Bulgarians also began to use coins around the same time. By the 5th century, all the Mediterranean countries were making use of coins. Gold coins were the most valuable, followed by silver and finally copper.



Coins

Greek coinage lasted for about 500 years. The Romans picked up the idea of coinage from them. Slowly the system of coinage declined after 500 years. The coins slowly looked thin and unattractive. The Celtic and German tribes, who had close contact with the Greeks and Romans, also began the coinage system by the 2nd century BC. At first they copied the Greek coins but later changed them to abstract shapes from heads, horses and chariots.

The Chinese at first used cowrie shells as coins. Later they shaped bronze coins in the shape of cowrie shells, knives and hoes. The proper coins were issued in 212 BC by the First Emperor of the Qin dynasty.

By the 15th century the art of coinage was revived as metal became more plentiful. Skilled artists engraved the coins. The first British coins were struck before the arrival of the Romans to Britain.

Coins are made by punching a piece of metal with the design of a coin on it. The Chinese cast their coins in moulds. The coins are made in a 'mint'. Coins usually have pictures and some writing

on them. They also have a milled edge. This was originally used on gold and silver coins to avoid fraudulent 'clipping' of the edges of the precious -metal coins. The tradition is still continued to this day.

23. Who invented plastic?

Plastic is a very common household item in the modern world. Plastic means 'capable of being moulded'. Plastic can be moulded to different shapes while still in a molten stage.

The first plastic ever produced was called Parkesine. It was made in 1862 from cellulose by a British chemist, Alexander Parkes. It was made to look and feel like ivory. A few years later in 1865, John Wesley Hyatt made a kind of plastic for billiard balls. However they were not very successful, as they tended to explode when they hit each other. In 1870, Hyatt with his brother Isaiah patented their discovery of the celluloid.

Celluloid had many drawbacks but it resulted in several developments in this field. In 1907, Leo Baekland discovered the phenolic plastic. It was the first entirely synthetic material to be produced in large quantities. Since then many varieties of plastics have been invented.

There are many kinds of plastics now. Polythene is a very common kind of plastic used for making bags, sacks, pipes and buckets. Polypropylene is tougher and is used to make car parts and chairs. Polycarbonate is used for machine parts, helmets, compact discs and unbreakable windows. Nylon and polyester are strong plastics that are often made into fibre for clothes, carpets and other textiles. Kevlar is even stronger than steel and is used to make bulletproof vests and parts of cars and planes. Teflon is the most modern of plastics invented. It is found everywhere from the non-stick pans in the kitchen to the spaceships and rockets. It has a unique property of being self lubricating. There are so many types of plastics and they are used in practically every field of life.

INTERESTING INFORMATION

The first international passenger service was started from London to Paris in 1919. During those days the bombers used in the World War I were adapted to make passenger aircraft.

The Boeing 747 'jumbo jet' was the first of the wide-bodied jets. It can carry 600 passengers and can fly a third of the way round the world nonstop.

The Concorde made its first flight at Bristol, England, in 1969. It is a supersonic (faster than sound) airplane. It can travel at twice the speed of sound and can cross the Atlantic in just 3 hours. It can carry 144 passengers.

The rainbow, a spectrum of seven colours, has always captivated Man by its sheer beauty. This multicoloured arch of light in the sky after a shower has fascinated many a poet into writing lyrics in praise of it. No one really understood the cause of the rainbow after a downpour of rain. It was Theodoric of Freibury who, in the 14th century, discovered how a rainbow was created. According to him it was caused by the refraction, reflection and dispersion of the sun's rays through the raindrops or mist.

Scientists today say that the force of gravity of the Earth seems to be changing. It was getting weaker. Newton's apple took one second to fall. Today the same apple will take longer. According to scientists, this is so because as the Earth, as well as the Universe, is getting older the force of gravity also weakens.

Alexander Graham Bell (1847-1922) a Scottish born US scientist and inventor not only invented the telephone (in 1876) but also did a lot of research and work in the fields of air conditioning and sheep breeding. He also tried to convert seawater to drinking water and experimented with some types of phonographs.

John Dalton (1766-1844) the English chemist, was the first person to note and record colour blindness. Surprisingly, he himself was colour blind.

Rutherford Ernest (1871-1937) was a New Zealand physicist and a pioneer of modern atomic science. His main research was in the field of radioactivity. It was he who discovered the alpha, beta and gamma rays. He received the famed Nobel Prize in 1908.

Alfred Bernhard Nobel (1833- 1896) was a Swedish chemist and engineer, who invented the dynamite in 1866. In 1889 he invented ballistite, smokeless gunpowder. He also invented gelignite, a highly explosive material. Nobel amassed a lot of wealth in the manufacture of explosives. He set up a fund to give a special prize to those who excelled in certain fields. These five prizes for science, world peace and literature are known as the famed Nobel Prizes.

The first nuclear submarine, the USS Nautilus, was built in 1954. In 1958, it traveled under the Arctic ice and surfaced at the North Pole.

The world's biggest submarines are the Russian Typhoon Class. They weigh over 26,000 tonnes.

In 1960, the submarine Trieste, reached a record of a depth of 11,000 metres.

The first baby incubator was invented by Budin, a Frenchman. In 1880 he made a wooden cabinet which was kept warm by pots of hot water. In 1891 another Frenchman, Dr. Alexandre Lion, devised a more sophisticated design. It was able to filter air and keep a constant temperature.

The idea of the contact lenses was originally suggested by the British astronomer, Sir John Herschel, in 1827. By the end of the century, a Swiss doctor, Eugen Frick of Zurich, devised the first

precision lenses. In 1887 the first contact lenses were manufactured in Jena, which is now in Germany.

Did you know that the modern ball-point pen was made specifically for the use of the American Air Force pilots? The aircraft crew required a pen that could be used during flights. There was to be no spilling of ink due to reduction of air pressure at high altitudes. The first modern ball-point pen was developed in 1943. Before that the first model of a ball-point pen was made in 1888 by American John H. Loud. He had made it in order to write on rough surfaces.

Escalators began to make their appearance by the 1930s. An escalator is a continuously moving staircase. The longest escalator is the one in St Petersburg Underground in Russia. It has 729 steps and a vertical rise of 59.68 m.

The technique of In vitro fertilization was introduced by Dr Robert Edwards and Patrick Steptoe, two British doctors. This helped several desperate couples who were unable to produce a child in the normal way. The first test-tube baby, Louise Brown, was born in 1978. The first Indian test tube baby was born in 1986.

Blood transfusion did not become safe until 1900, when Karl Landsteiner, an Austrian pathologist, identified the four different types of blood groups. His findings made it possible to match donors and patients.

The guillotine was named after Joseph Ignace Guillotin, the French physician. However he was not the inventor. It was used in Ireland in 1307 and in 1587 an English historian described the 'Halifax gibbet', a beheading device, being used in England at the time.

The first toothbrush was made in China in 1498. It began to be used in Europe by the 17th century. Various powders and pastes

were sold as cleaning agents. The first collapsible toothpaste tube was Dr Zierner's 'Alexandra Dentifrices' which was made in 1891.

Fingerprints are unique, but all of them share common characteristics. Edward Henry established the fingerprint classifications in 1896. The five basic types are still in use today.

The first dry-cleaning company was established in 1885. Jean-Baptiste Jolly of Paris had accidentally dropped camphene, a type of fuel, on a dress. He feared that he had spoilt the dress. However, he noticed that the dress actually seemed cleaner.

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DISCOVERIES & INVENTIONS

Man has always been fascinated by science & technology and the advantages it provides to us, making our life more comfortable and happy.

Great scientists like Galileo Galilei, Alexander Graham Bell, Benjamin Franklin, Thomas Edison, Issac Newton, to name a few, have revolutionised the whole concept of living on this earth.

If Benjamin Franklin had not experimented with electricity, our lives would have become gloomy and dark. If Graham Bell had not invented the telephone, we would have found it difficult to communicate with our friends and relatives staying far off.

The first toothbrush was made in China in 1498.

John Dalton was the first person to note and record colour blindness. Surprisingly, he himself was colour blind.

Did you know that the modern ball-point pen was made specifically for the use of the American Air Force so that there was no spilling of ink due to reduction of air pressure at high altitudes?

These great inventions and discoveries by intelligent human beings, have made our lives a more pleasurable experience.

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